# GEOLOGY OF MATADERO CREEK FROM FOOTHILL FREEWAY TO THE PALO ALTO FLOOD BASIN

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## Geologic and Hydrogeologic Setting

Matadero Creek drains a relatively small area along the northwest edge of the Santa Clara Valley. Its headwaters are in the Santa Cruz Mountains, and it enters the valley floor at approximately Foothill Freeway near the City of Palo Alto at an elevation of approximately 100 feet. From Foothill, Matadero Creek slopes to the northeast and enters San Francisco Bay via Mayfield Slough.

The study area extends from Foothill Freeway to the Palo Alto Flood Basin.

At the upstream end of the study area, Matadero Creek flows across the Santa Clara Formation, of Tertiary age, which consists of compacted to loosely-consolidated conglomerates, sandstones, and siltstones. At approximately Laguna Avenue, the creek enters an alluvial fan composed of gravel and unconsolidated materials consisting of sands and silty sands, deposited by streams as they flow into the valley. Further downstream, between Alma and Middlefield Roads, the area is mapped as interfluvial basin deposits, primarily organic clays and silty clays (Helley & Brabb, 1971). Downstream from this area are "older bay muds." Franciscan bedrock is located at depth in the study area.

The study area is located in the San Francisquito subarea of the San Mateo groundwater basin and is adjacent to the Santa Clara groundwater basin. According to the California Department of Water Resources (1967), the total thickness of the alluvial fan aquifer in this subarea is over 1,000 feet, and there are two major aquifer zones, an upper unconfined zone, and a lower confined zone. These two zones are separated by a major aquitard, which extends upstream to approximately Foothill Freeway. The bottom of the major aquitard is approximately

150 feet below the ground surface. Within the unconfined aquifer zone, two very thin primary production zones have been identified, at depths of approximately 20 and 45 feet.

Upstream from the edge of the major aquitard is the upper fan zone, which consists of very poorly-defined alternating lenses of permeable and semi-permeable material. Groundwater in this zone is generally unconfined, and this zone serves as a source of recharge to the confined aquifer beneath the major aquitard. For this reason, this zone is known as the "forebay."

## Channel Morphology

On early maps (Thompson & West, 1876), the channel of Matadero Creek appeared in approximately the same location and configuration as it does today. As it meandered down the surface of a gently-sloping alluvial fan, it appeared to be confined to a well-defined incised channel. As it crossed the Southern Pacific Railroad tracks near what is now Alma Avenue, the channel lost its definition as the land surface flattened out in the basin and marine baylands deposits. Flows seemed to have overflowed then and became tributary to Permanente Creek, which previously flowed into San Francisco Bay via Charleston Slough.

Matadero Creek now flows into Mayfield Slough, which is an estuary of San Francisco Bay. Between El Camino Real and just upstream from Bayshore Freeway (U. S. 101), the channel is concrete-lined for flood control purposes.

## Soils

According to the Santa Clara County soil survey (USDA, 1968), the uppermost part of this reach (Foothill to El Camino Real) is underlain by soils of the drained Clear Lake-Campbell soil association. From El Camino Real to Middlefield Road, the predominant soil type is the Sunnyvale-Castro-Clear Lake Association, and the remainder of the reach has developed on the Alviso and Tidal Marsh Associations. These four soil associations range from somewhat poorly-drained to very poorly-drained, have low permeabilities, and severe limitations for septic tank filter fields. The shrink-swell potential of these soils is generally high, and the Alviso and Tidal Marsh Associations have high salinity. The soil erosion hazard in these associations is none to slight.

## Land Subsidence

Prior to 1920, there were many flowing artesian wells throughout the Baylands. As agriculture became more prominent in the Santa Clara Valley, the demand for irrigation water increased. With increased pumping, a serious overdraft of water from the confined artesian aquifer had occurred by the 1960's, the result of which was serious land subsidence due to reduction of artesian pressure. By 1967, a small area just south of Moffett Field had subsided more than 7 feet, and some parts of San Jose had subsided 9 feet or more. Since 1912, the subsidence in the Palo Alto Flood Basin has been estimated as 1 - 2 feet (Poland, 1969). The maximum recorded subsidence along the subject reach of Matadero Creek from 1934 to 1967 was 3 feet.

## Seismicity

In a report on Baylands planning, by Tudor Engineering (1973), four geologic "risk zones" were established to define seismic and static loading risks. Soil liquefaction and lateral spreading, ground motion, and levee stability, were addressed in the Tudor report.

Most of Matadero Creek (upstream from U. S. 101) is in Risk Zone A, in which insignificant surface effects resulting from a large earthquake may be expected. In Risk Zone B, liquefaction of deep granular layers may result in settlement of soil. This zone has not been identified along Matadero Creek. That portion of Matadero Creek which is located in the flood basin, however, is extremely subject to liquefaction of shallow alluvial layers or ground failure by lateral spreading as a result of a large earthquake, as it is characterized by bay mud overlain by alluvium. This area is in Risk Zone D. In Risk Zone C, liquefaction of bay mud is not likely, but moderate to substantial differential settlement may result from consolidation of the mud.

The Tudor report estimated that ground acceleration greater than 0.4g is possible in the Baylands area as a result of a strong earthquake. In areas of Risk Zone D subject to liquefaction, soils may liquefy if the ground acceleration is as much as 0.15 or 0.2g.

Levee stability during earthquakes in the Baylands is dependent on local soil conditions, ground acceleration, and the magnitude of the earthquake.

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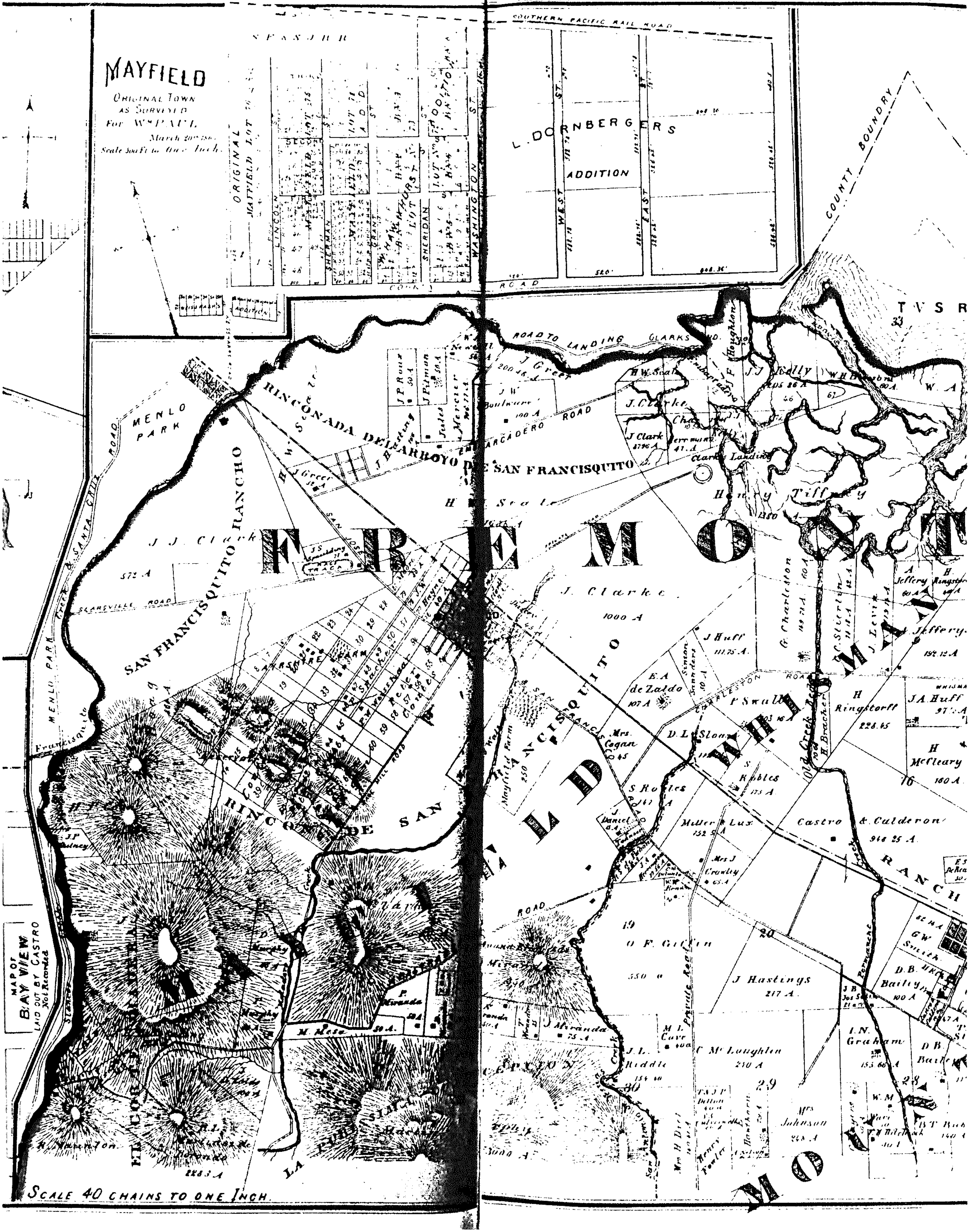
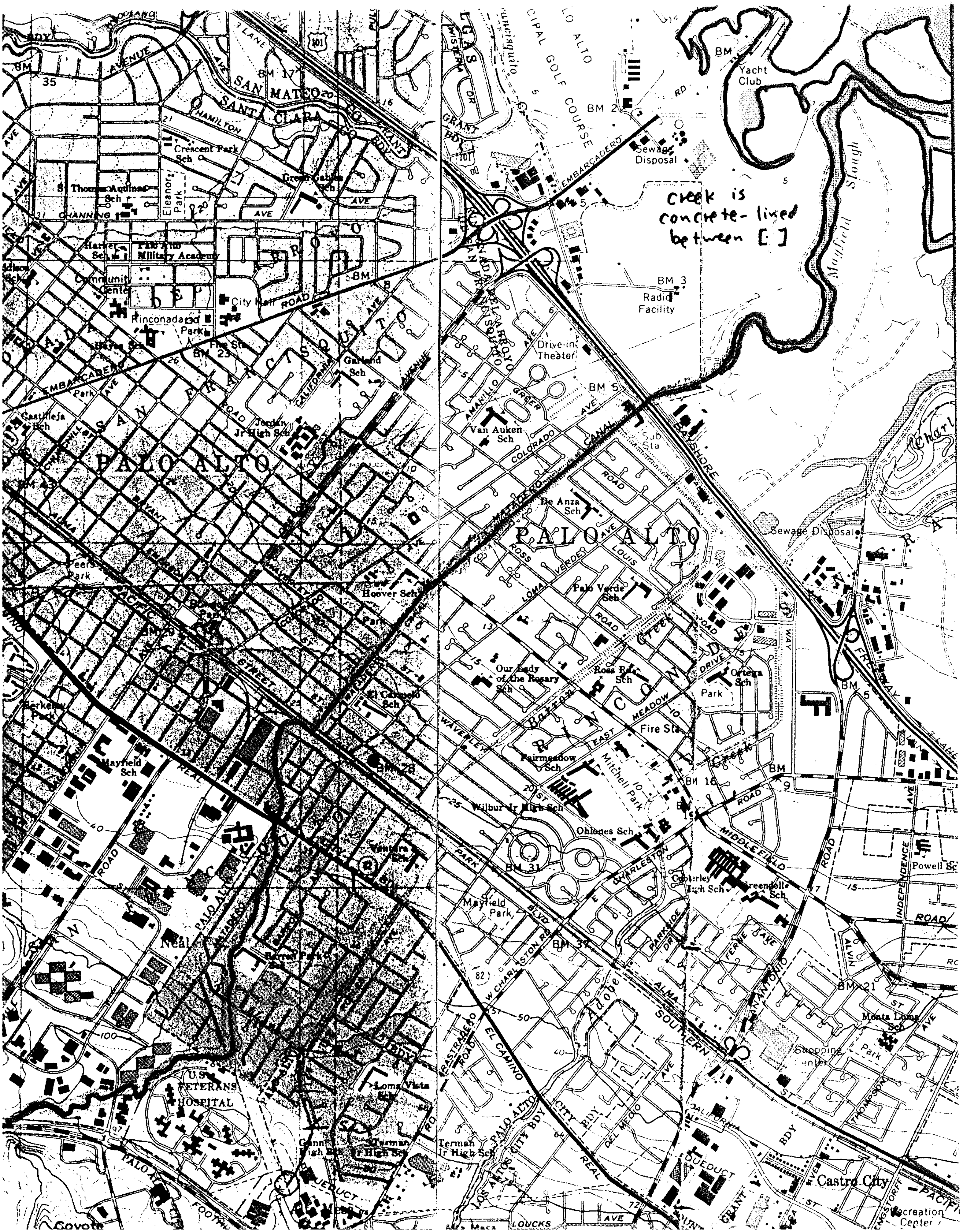
# MAP NUMBER ONE





Creek is concrete-lined between [ ]